

## PROJECT ADMINISTRATION DATA SHEET



ORIGINAL



REVISION NO. \_\_\_\_\_

Project No. A-3480 GTRI/GITx DATE 3/30/83Project Director: Mark G. Frost ~~SAW/~~Lab EML/HOSponsor: U. S. Army Missile Command; Redstone Arsenal, AL 35898Type Agreement: Delivery Order No. 0001 under Contract DAAH01-83-D-A013Award Period: From 2/1/83 To 8/1/83 (Performance) 10/1/83 (Reports)Sponsor Amount: Total Estimated: \$ 13,500 Funded: \$ 13,500Cost Sharing Amount: \$ None Cost Sharing No: \_\_\_\_\_Title: Optimum Guidance Law Development

## ADMINISTRATIVE DATA

OCA Contact Frank H. Huff

## 1) Sponsor Technical Contact:

Dr. M. M. HallumSystems Simulation & Dev. DirectorateUS Army Missile CommandUS Army Missile LaboratoryATTN; DRSMI-RDFRedstone Arsenal, AL 35898

## 2) Sponsor Admin/Contractual Matters:

Mr. Thomas A. BryantOffice of Naval ResearchRoom 206, O'Keefe Bldg.Georgia Institute of TechnologyAtlanta, Georgia 30332Defense Priority Rating: DO-A2 under DMS Reg 1 Military Security Classification: Unclassified (general  
(or) Company/Industrial Proprietary: scope of work)

## RESTRICTIONS

See Attached Gov't Supplemental Information Sheet for Additional Requirements.

Travel: Foreign travel must have prior approval - Contact OCA in each case. Domestic travel requires sponsor

approval where total will exceed greater of \$500 or 125% of approved proposal budget category. See additional res

trictions on re-budgeting travel funds: (2) C-2(f) (page 4 of basic agreement)

Equipment: Title vests with (1) B-2(c) (page 3 of basic agreement)

Government; except that items costing less than \$1,000 vest with GIT if prior approval to

purchase is obtained from the Contracting Officer.

## COMMENTS:

Send information copy of all correspondence addressed to Administrative ContractingOfficer (ACO) to Commander, US Army Missile Command, Attn: DRSMI-ICD<sup>3</sup>, RedstoneArsenal, AL 35898

## COPIES TO:

Research Administrative Network

Research Property Management

Accounting

Procurement/EES Supply Services

Research Security Services

Reports Coordinator (OCA)

GTRI

Library

Research Communications (2)

Project File

Other 1

Other

SPONSORED PROJECT TERMINATION/CLOSEOUT SHEETDate October 20, 1983Project No. A-3480~~XXXX~~ Lab EML/HOIncludes Subproject No.(s) NoneProject Director(s) Mark G. FrostGTRI ~~XXXX~~Sponsor U.S. Army Missile CommandTitle: Optimum Guidance Law DevelopmentEffective Completion Date: 8/1/83 (Performance) 10/1/83 (Reports)

## Grant/Contract Closeout Actions Remaining

- ☐ None
- ☒ Final Invoice ~~xx Final Invoice xx~~
- ☐ Closing Documents
- ☒ Final Report of Inventions
- ☒ Govt. Property Inventory & Related Certificate
- ☐ Classified Material Certificate
- ☐ Other \_\_\_\_\_

Continues Project No. N/AContinued by Project No. N/A

## COPIES TO:

Project Director  
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Reports Coordinator (OCA) ✓

Library  
GTRI  
Research Communications (2)  
Project File  
Other \_\_\_\_\_

Monthly Performance and Cost Report No. 1

Report Period  
February 1 through February 28, 1983

Report Prepared  
March 23, 1983

OPTIMUM GUIDANCE LAW DEVELOPMENT

M. G. Frost

Contract No. DAAH01-83-D-A013  
Delivery Order No. 0001  
Project No. A-3480

Effective Date: 02/01/83  
Expiration Date: 08/01/83

Prepared for

U. S. Army Missile Command  
Attn: DRSMI-ICDB/Glass  
Redstone Arsenal, Alabama 35898

Prepared by

Georgia Institute of Technology  
Engineering Experiment Station  
Atlanta, Georgia 30332

WORK PERFORMED DURING THIS PERIOD

No work has been performed to date on this task.

PROBLEMS ENCOUNTERED

None

WORK TO BE PERFORMED

- o Literature search on adjoint methods and guidance laws
- o Evaluation of previous ATBM data

### A-3480 Cost Information

The following charges have been incurred against the contract during period February 1 through February 28, 1983.

	<u>Expended</u>	<u>Encumbered</u>
Personal Services (PS)	\$ -0-	\$ -0-
Fringe Benefits	-0-	-0-
Materials and Supplies	-0-	-0-
Travel	-0-	-0-
Subtotal	<u>-0-</u>	<u>-0-</u>
Equipment	-0-	-0-
Overhead (@ 47.2% of Subtotal)	-0-	-0-
TOTAL	<u>\$ -0-</u>	<u>\$ -0-</u>

The breakdown of personal services is as follows:

	<u>Dollars</u>	<u>Approximate Man Hours</u>
Principal Research Scientists/Engineers	\$ -0-	-0-
Senior Research Scientists/Engineers	-0-	-0-
Research Scientists II/Engineers II	-0-	-0-
Research Scientists I/Engineers I	-0-	-0-
Technicians/Draftsmen	-0-	-0-
Students	-0-	-0-
Secretarial/Clerical/Other	-0-	-0-
TOTAL	<u>\$ -0-</u>	<u>-0-</u>

The current financial status of the contract is as follows:

	<u>Budget As Proposed</u>	<u>Expended</u>	<u>Encumbered</u>	<u>Free Balance</u>
Personal Services (PS)	\$ 6,783.00	\$ -0-	\$ -0-	\$ 6,783.00
Fringe Benefits	1,423.00	-0-	-0-	1,423.00
Materials and Supplies	579.00	-0-	-0-	579.00
Travel and Shipping	386.00	-0-	-0-	386.00
Overhead	4,329.00	-0-	-0-	4,329.00
FUNDING	<u>\$ 13,500.00</u>	<u>\$ -0-</u>	<u>\$ -0-</u>	<u>\$ 13,500.00</u>

Based on present full funding, the funding and equivalent man hours are sufficient to complete the task.

Monthly Performance and Cost Report No. 2

Report Period  
March 1 through March 31, 1983

Report Prepared  
April 26, 1983

OPTIMUM GUIDANCE LAW DEVELOPMENT

M. G. Frost

Contract No. DAAH01-83-D-A013  
Delivery Order No. 0001  
Project No. A-3480

Effective Date: 02/01/83  
Expiration Date: 08/01/83

Prepared for

U. S. Army Missile Command  
Attn: DRSMI-ICDB/Glass  
Redstone Arsenal, Alabama 35898

Prepared by

Georgia Institute of Technology  
Engineering Experiment Station  
Atlanta, Georgia 30332

#### WORK PERFORMED DURING THIS PERIOD

- o Literature search of classified data has provided threat definitions and methodology of previous work.
- o Digital Simulator has been modified to model these threats and present missile performance in ATBM scenarios.
- o Initial validation of simulation results with previous ATBM studies started.

#### PROBLEMS ENCOUNTERED

None

#### WORK TO BE PERFORMED

- o Collation of previous RFSS results for comparison with simulator performance using modified guidance laws.
- o Investigate using guidance constant which is programmable as a function of time.

A-3480 Cost Information

The following charges have been incurred against the contract during period March 1 through March 31, 1983.

	<u>Expended</u>	<u>Encumbered</u>
Personal Services (PS)	\$ 6,929.35	\$ -0-
Fringe Benefits	1,316.77	-0-
Materials and Supplies	-0-	-0-
Travel	-0-	-0-
Subtotal	8,246.12	-0-
Equipment	-0-	-0-
Overhead (@ 47.2% of Subtotal)	3,892.17	-0-
TOTAL	\$ 12,138.29	\$ -0-

The breakdown of personal services is as follows:

	<u>Dollars</u>	<u>Approximate Man Hours</u>
Principal Research Scientists/Engineers	\$ -0-	-0-
Senior Research Scientists/Engineers	3,372.63	83
Research Scientists II/Engineers II	-0-	-0-
Research Scientists I/Engineers I	2,291.57	87
Technicians/Draftsmen	-0-	-0-
Students	1,015.55	101
Secretarial/Clerical/Other	249.60	18
TOTAL	\$ 6,929.35	289

The current financial status of the contract is as follows:

	<u>Budget As Proposed</u>	<u>Expended</u>	<u>Encumbered</u>	<u>Free Balance</u>
Personal Services (PS)	\$ 6,783.00	\$ 6,929.35	\$ -0-	\$ (146.35)
Fringe Benefits	1,423.00	1,316.77	-0-	106.23
Materials and Supplies	579.00	-0-	-0-	579.00
Travel and Shipping	386.00	-0-	-0-	386.00
Overhead	4,329.00	3,892.17	-0-	436.83
FUNDING	\$ 13,500.00	\$ 12,138.29	\$ -0-	\$ 1,361.71

Based on present full funding, the funding and equivalent man hours are sufficient to complete the task. Approximately 90% of the proposed task has been completed.



Monthly Technical Report No. 3  
and  
Monthly Cost and Performance Report No. 3

Report Period  
April 1 through April 30, 1983

Report Prepared  
May 31, 1983

OPTIMUM GUIDANCE LAW DEVELOPMENT

M. G. Frost

Contract No. DAAH01-83-D-A013  
Delivery Order No. 0001  
Project No. A-3480

Effective Date: 02/01/83  
Expiration Date: 08/01/83

Prepared for

U. S. Army Missile Command  
Attn: DRSMI-ICDB/Glass  
Redstone Arsenal, Alabama 35898

Prepared by

Georgia Institute of Technology  
Engineering Experiment Station  
Atlanta, Georgia 30332

#### WORK PERFORMED DURING THIS PERIOD

- o Optimum constant values for guidance gain obtained against spectrum of ATBM targets.
- o Investigated using Signal to Noise ratio as a factor in determining guidance gain in a Benign Environment.
- o Implemented new model of monopulse processing in digital simulation.

#### PROBLEMS ENCOUNTERED

None

#### WORK TO BE PERFORMED

- o Investigate non-minimum energy trajectories.
- o Investigate terminal evasive maneuver effects on gain selection.

# Cost and Performance Report No. 3

Contract DAAH01-83-D-A013

GT/EES Project A-3480-000

The following charges have been incurred against the contract during period April 1 through April 30, 1983.

	<u>Expended</u>	<u>Encumbered</u>
Personal Services (PS)	\$ 8.73	\$ -0-
Fringe Benefits	2.67	-0-
Materials and Supplies	6.40	-0-
Travel	-0-	-0-
Subtotal	<u>17.80</u>	<u>-0-</u>
Equipment	-0-	-0-
Overhead (@ 47.2% of Subtotal)	8.38	-0-
TOTAL	\$ <u>26.18</u>	\$ <u>-0-</u>

The breakdown of personal services is as follows:

	<u>Dollars</u>	<u>Approximate Man Hours</u>
Principal Research Scientists/Engineers	\$ -0-	-0-
Senior Research Scientists/Engineers	-0-	-0-
Research Scientists II/Engineers II	-0-	-0-
Research Scientists I/Engineers I	-0-	-0-
Technicians/Draftsmen	-0-	-0-
Students	-0-	-0-
Secretarial/Clerical/Other	8.73	1
TOTAL	\$ <u>8.73</u>	<u>1</u>

The current financial status of the contract is as follows:

	<u>Budget As Proposed</u>	<u>Expended</u>	<u>Encumbered</u>	<u>Free Balance</u>
Personal Services (PS)	\$ 6,783.00	\$ 6,946.81	\$ -0-	\$ (163.81)
Fringe Benefits	1,423.00	1,319.44	-0-	103.56
Materials and Supplies	579.00	6.40	-0-	572.60
Travel	386.00	-0-	-0-	386.00
Overhead	4,329.00	3,900.57	-0-	428.43
FUNDING	\$ <u>13,500.00</u>	\$ <u>12,173.22</u>	\$ <u>-0-</u>	\$ <u>1,326.78</u>

Based on present full funding, the funding and equivalent man hours are sufficient to complete the task. Approximately 90% of the proposed task has been completed.

Monthly Technical Report No. 4  
and  
Monthly Cost and Performance Report No. 4

Report Period  
May 1 through May 31, 1983

Report Prepared  
June 27, 1983

OPTIMUM GUIDANCE LAW DEVELOPMENT

M. G. Frost

Contract No. DAAH01-83-D-A013  
Delivery Order No. 0001  
Project No. A-3480

Effective Date: 02/01/83  
Expiration Date: 08/01/83

Prepared for  
  
U. S. Army Missile Command  
Attn: DRSMI-ICDB/Glass  
Redstone Arsenal, Alabama 35898

Prepared by  
  
Georgia Institute of Technology  
Engineering Experiment Station  
Atlanta, Georgia 30332

WORK PERFORMED DURING THIS PERIOD

No contract work was performed during this period.

PROBLEMS ENCOUNTERED

None

WORK TO BE PERFORMED

- o Investigate non-minimum energy trajectories.
- o Investigate terminal evasive maneuver effects on gain selection.

Cost and Performance Report No. 4

Contract DAAH01-83-D-A013

GT/EES Project A-3480-000

The following charges have been incurred against the contract during period May 1 through May 31, 1983.

	<u>Expended</u>	<u>Encumbered</u>
Personal Services (PS)	\$ -0-	\$ -0-
Fringe Benefits	-0-	-0-
Materials and Supplies	-0-	-0-
Travel	-0-	-0-
Subtotal	<u>-0-</u>	<u>-0-</u>
Equipment	-0-	-0-
Overhead (@ 47.2% of Subtotal)	-0-	-0-
TOTAL	\$ <u>-0-</u>	\$ <u>-0-</u>

The breakdown of personal services is as follows:

	<u>Dollars</u>	<u>Approximate Man Hours</u>
Principal Research Scientists/Engineers	\$ -0-	-0-
Senior Research Scientists/Engineers	-0-	-0-
Research Scientists II/Engineers II	-0-	-0-
Research Scientists I/Engineers I	-0-	-0-
Technicians/Draftsmen	-0-	-0-
Students	-0-	-0-
Secretarial/Clerical/Other	-0-	-0-
TOTAL	\$ <u>-0-</u>	<u>-0-</u>

The current financial status of the contract is as follows:

	<u>Budget As Proposed</u>	<u>Expended</u>	<u>Encumbered</u>	<u>Free Balance</u>
Personal Services (PS)	\$ 6,783.00	\$ 6,946.81	\$ -0-	\$ (163.81)
Fringe Benefits	1,423.00	1,319.44	-0-	103.56
Materials and Supplies	579.00	6.40	-0-	572.60
Travel	386.00	-0-	-0-	386.00
Overhead	4,329.00	3,900.57	-0-	428.43
FUNDING	\$ 13,500.00	\$ 12,173.22	\$ <u>-0-</u>	\$ <u>1,326.78</u>

Based on present full funding, the funding and equivalent man hours are sufficient to complete the task. Approximately 90% of the proposed task has been completed.

Monthly Technical Report No. 5  
and  
Monthly Cost and Performance Report No. 5

Report Period  
June 1 through June 30, 1983

Report Prepared  
July 27, 1983

OPTIMUM GUIDANCE LAW DEVELOPMENT

M. G. Frost

Contract No. DAAH01-83-D-A013  
Delivery Order No. 0001  
Project No. A-3480

Effective Date: 02/01/83  
Expiration Date: 08/01/83

Prepared for  
  
U. S. Army Missile Command  
Attn: DRSMI-ICDB/Glass  
Redstone Arsenal, Alabama 35898

Prepared by  
  
Georgia Institute of Technology  
Engineering Experiment Station  
Atlanta, Georgia 30332

WORK PERFORMED DURING THIS PERIOD

No contract work was performed during this period.

PROBLEMS ENCOUNTERED

None

WORK TO BE PERFORMED

- o Investigate non-minimum energy trajectories.
- o Investigate terminal evasive maneuver effects on gain selection.



# Cost and Performance Report No. 5

Contract DAAH01-83-D-A013, D.O. 0001

GT/EES Project A-3480-000

The following charges have been incurred against the contract during period June 1 through June 30, 1983.

	<u>Expended</u>	<u>Encumbered</u>
Personal Services (PS)	\$ 33.36	-0-
Fringe Benefits	8.50	-0-
Materials and Supplies	6.40	-0-
Travel	-0-	-0-
Subtotal	<u>48.26</u>	\$ <u>-0-</u>
Equipment	-0-	-0-
Overhead (@ 47.2% of Subtotal)	22.78	-0-
TOTAL	\$ <u>71.04</u>	\$ <u>-0-</u>

The breakdown of personal services is as follows:

	<u>Dollars</u>	<u>Approximate Man Hours</u>
Principal Research Scientists/Engineers	\$ -0-	-0-
Senior Research Scientists/Engineers	-0-	-0-
Research Scientists II/Engineers II	-0-	-0-
Research Scientists I/Engineers I	-0-	-0-
Technicians/Draftsmen	-0-	-0-
Students	-0-	-0-
Secretarial/Clerical/Other	33.36	2
TOTAL	\$ <u>33.36</u>	<u>2</u>

The current financial status of the contract is as follows:

	<u>Budget As Proposed</u>	<u>Expended</u>	<u>Encumbered</u>	<u>Free Balance</u>
Personal Services (PS)	\$ 6,783.00	\$ 6,971.44	\$ -0-	\$ (188.44)
Fringe Benefits	1,423.00	1,327.94	-0-	95.06
Materials and Supplies	579.00	19.20	-0-	559.80
Travel	386.00	-0-	-0-	386.00
Overhead	4,329.00	3,926.37	-0-	402.63
FUNDING	\$ <u>13,500.00</u>	\$ <u>12,244.95</u>	\$ <u>-0-</u>	\$ <u>1,255.05</u>

Based on present full funding, the funding and equivalent man hours are sufficient to complete the task. Approximately 90% of the proposed task has been completed.

Monthly Technical Report No. 6  
and  
Monthly Cost and Performance Report No. 6

Report Period  
July 1 through July 31, 1983

Report Prepared  
August 25, 1983

OPTIMUM GUIDANCE LAW DEVELOPMENT

M. G. Frost

Contract No. DAAH01-83-D-A013  
Delivery Order No. 0001  
Project No. A-3480

Effective Date: 02/01/83  
Expiration Date: 08/01/83

Prepared for

U. S. Army Missile Command  
Attn: DRSMI-ICDB/Glass  
Redstone Arsenal, Alabama 35898

Prepared by

Georgia Institute of Technology  
Engineering Experiment Station  
Atlanta, Georgia 30332

#### WORK PERFORMED DURING THIS PERIOD

- o Investigated detection algorithms to allow guidance gain choice dependent upon ATBM terminal maneuvers.

#### PROBLEMS ENCOUNTERED

None

#### WORK TO BE PERFORMED

- o Complete Final Report

# Cost and Performance Report No. 6

Contract DAAH01-83-D-A013, D.O. 0001

GT/EES Project A-3480-000

The following charges have been incurred against the contract during period July 1 through July 31, 1983.

	<u>Expended</u>	<u>Encumbered</u>
Personal Services (PS)	\$ -0-	-0-
Fringe Benefits	-0-	-0-
Materials and Supplies	1.20	-0-
Travel	-0-	-0-
Subtotal	<u>1.20</u>	\$ -0-
Equipment	-0-	-0-
Overhead (@ 47.2% of Subtotal)	.59	-0-
TOTAL	\$ <u>1.79</u>	\$ -0-

The breakdown of personal services is as follows:

	<u>Dollars</u>	<u>Approximate Man Hours</u>
Principal Research Scientists/Engineers	\$ -0-	-0-
Senior Research Scientists/Engineers	-0-	-0-
Research Scientists II/Engineers II	-0-	-0-
Research Scientists I/Engineers I	-0-	-0-
Technicians/Draftsmen	-0-	-0-
Students	-0-	-0-
Secretarial/Clerical/Other	-0-	-0-
TOTAL	\$ <u>-0-</u>	<u>-0-</u>

The current financial status of the contract is as follows:

	<u>Budget As Amended</u>	<u>Expended</u>	<u>Encumbered</u>	<u>Free Balance</u>
Personal Services (PS)	\$ 7,089.87	\$ 6,971.44	\$ -0-	\$ 118.43
Fringe Benefits	1,502.13	1,327.94	-0-	174.19
Materials and Supplies	579.00	20.40	-0-	558.60
Travel	-0-	-0-	-0-	-0-
Overhead	4,329.00	3,926.96	-0-	402.04
FUNDING	\$ <u>13,500.00</u>	\$ <u>12,246.74</u>	\$ <u>-0-</u>	\$ <u>1,253.26</u>

Based on present full funding, the funding and equivalent man hours are sufficient to complete the task. Approximately 91% of the proposed task has been completed.